

CLAIMS

What is claimed is:

1. A system for injecting spin-based electrons into silicon, comprising:
5 a ferromagnetic metal contact capable of transmitting carriers having a primary spin polarization; and
a silicide layer positioned between the ferromagnetic metal contact and the silicon, the silicide layer making ohmic contact with the silicon such that the spin-polarized carriers transmitted from the ferromagnetic metal contact can be injected
10 into the silicon without altering the primary spin polarization.
2. A system according to claim 1, further comprising:
a silicon substrate, the silicide layer being disposed on a surface of the silicon substrate and acting as a tunneling junction between the ferromagnetic metal contact
15 and the silicon substrate.
3. A system according to claim 1, wherein:
the ferromagnetic metal contact and silicide layer form a source electrode.
- 20 4. A system according to claim 1, further comprising:
a drain electrode contacting the silicon, the drain electrode including a ferromagnetic detection contact capable of receiving the spin-polarized carriers, and further including a second silicide layer disposed between the ferromagnetic detection contact and the silicon substrate such that the spin-polarized carriers flowing into the
25 ferromagnetic detection contact from the silicon substrate maintain spin polarization.
5. A system according to claim 1, further comprising:
a gate electrode positioned on the silicon substrate, the gate electrode capable of receiving a gate bias and applying an electric field across the silicon substrate such
30 that spin-injected carriers flowing through the electric field tend to change spin orientation.

6. A system according to claim 1, further comprising:

an external field generator capable of applying an electric field across the silicon such that spin-injected carriers flowing through the electric field tend to change spin orientation.

7. A system according to claim 1, further comprising:

a nanowire polygate positioned adjacent the silicon and capable of applying a magnetic field across the silicon such that spin-injected carriers flowing through the electric field tend to change spin orientation.

8. A system according to claim 1, wherein:

the silicide layer is a cobalt silicide layer.

9. A system according to claim 1, wherein:

the silicide layer is a nickel silicide layer.

10. A system according to claim 1, wherein:

the ferromagnetic metal contact is a cobalt ferromagnetic metal contact.

11. A system according to claim 1, wherein:

the ferromagnetic metal contact is a cobalt ferromagnetic metal contact.

12. A spin-based transistor, comprising:

a silicon substrate;

a source electrode on the silicon substrate, the source electrode including a ferromagnetic injection contact capable of injecting spin-polarized carriers into the silicon substrate, and further including a first silicide layer disposed between the ferromagnetic injection contact and the silicon substrate such that carriers injected into the silicon substrate maintain spin polarization;

a drain electrode on the silicon substrate, the drain electrode including a ferromagnetic detection contact capable of receiving spin-polarized carriers, and further including a second silicide layer disposed between the ferromagnetic detection contact and the silicon substrate such that carriers flowing into the ferromagnetic detection contact from the silicon substrate maintain spin polarization; and

5 a gate electrode positioned on the silicon substrate between the source electrode and gate electrode, the gate electrode capable of receiving a gate bias and applying an electric field across the silicon substrate between the source and gate electrodes such that carriers flowing through the electric field will change spin orientation.

10 13. A method for forming a contact for a spin-based device, comprising:
depositing a first ferromagnetic metal layer on a silicon substrate;
annealing the first ferromagnetic metal layer to form a layer of metal silicide,
15 the layer of metal silicide having a thickness allowing the layer to act as a tunneling junction for spin-polarized carriers; and
forming a second ferromagnetic layer on the layer of metal silicide, the second ferromagnetic layer operable as a ferromagnetic contact capable of injecting spin-polarized carriers through the layer of metal silicide into the silicon substrate without
20 loss of spin polarization.

14. A method according to claim 13, wherein:
annealing the ferromagnetic metal layer to form a layer of metal silicide includes annealing a first portion of the first ferromagnetic metal layer, the metal
25 silicide being in contact with the silicon layer, and
forming a second ferromagnetic layer includes not annealing a second portion of the first ferromagnetic layer in order to form a ferromagnetic metal contact, the ferromagnetic metal contact overlying the layer of metal silicide and capable of injecting spin-polarized carriers through the layer of metal silicide into the silicon
30 substrate without loss of spin polarization.

15. A method according to claim 13, wherein:

forming a second ferromagnetic layer includes depositing a second ferromagnetic metal layer on the layer of metal silicide, the second ferromagnetic layer operable as a ferromagnetic contact capable of injecting spin-polarized carriers through the layer of metal silicide into the silicon substrate without loss of spin polarization.

16. method according to claim 13, further comprising:

etching the layer of metal silicide to remove any unnecessary metal silicide.

17. method according to claim 13, further comprising:

applying a magnetic field to the second ferromagnetic layer in order to control the spin-polarization of the second ferromagnetic layer.

18. method according to claim 13, wherein:

annealing the first ferromagnetic metal layer to form a layer of metal silicide and forming a second ferromagnetic layer on the layer of metal silicide forms a source electrode for injecting spin-polarized carriers through the layer of metal silicide into the silicon substrate.

19. method according to claim 13, wherein:

annealing the first ferromagnetic metal layer to form a layer of metal silicide and forming a second ferromagnetic layer on the layer of metal silicide forms a drain electrode for receiving spin-polarized carriers from the silicon substrate through the layer of metal silicide.

20. method according to claim 13, further comprising:

depositing a gate electrode on the silicon substrate, the gate electrode capable of receiving a gate bias and applying an electric field across the silicon substrate such that spin-polarized carriers flowing through the electric field will change spin orientation.